DOE Review of RSVP Activities at BNL

27-28 January 2004

RHIC/RSVP Experimental Operations & RSVP Installation

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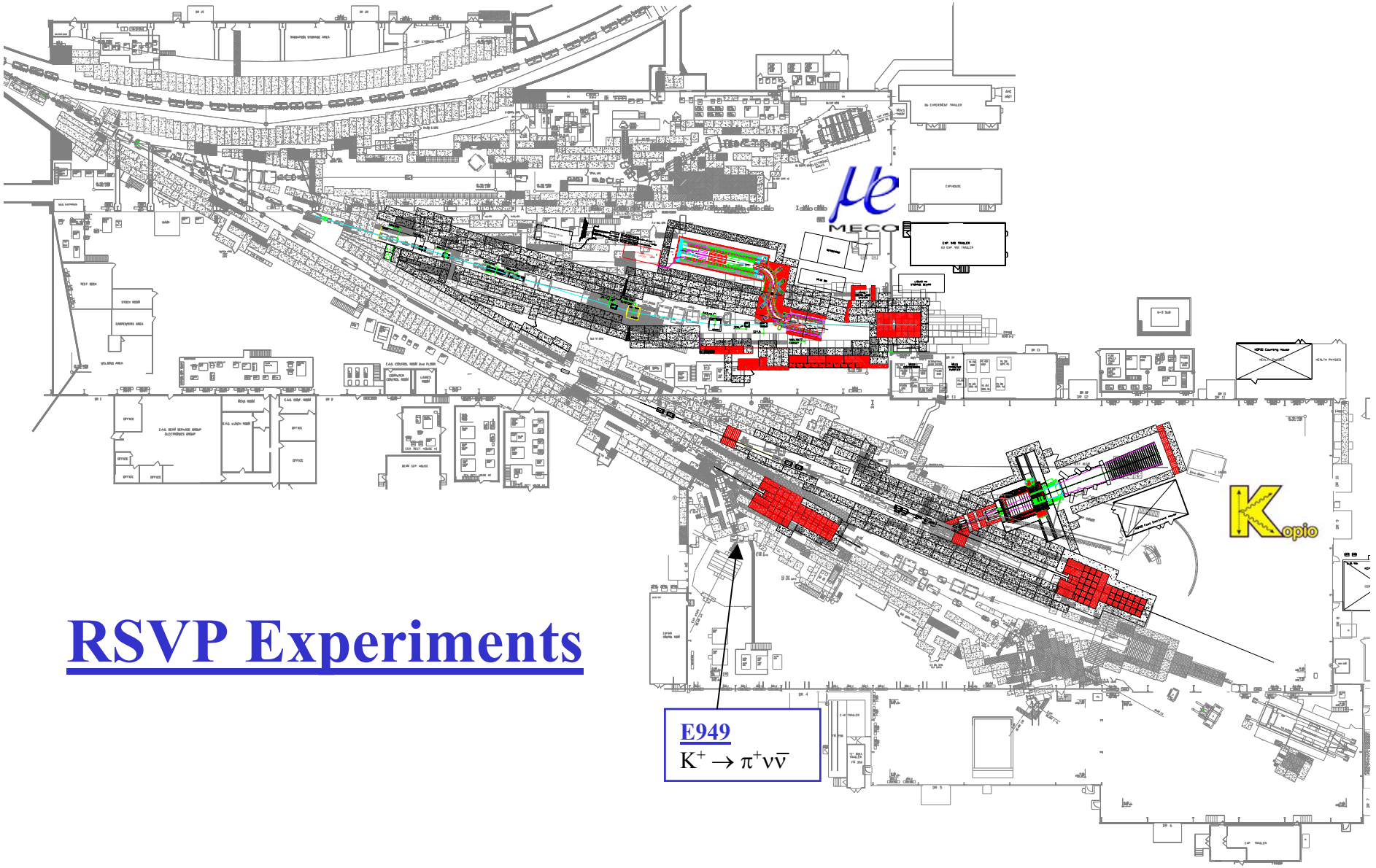
Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

Outline

- RSVP Installation
  - Common issues
  - K0PI0 Issues
  - MECO Issues
  - Impact on RHIC
- RSVP Operations
  - Cost basis
  - Support personnel
  - Impact on RHIC
- RSVP D&D
- Final Comments



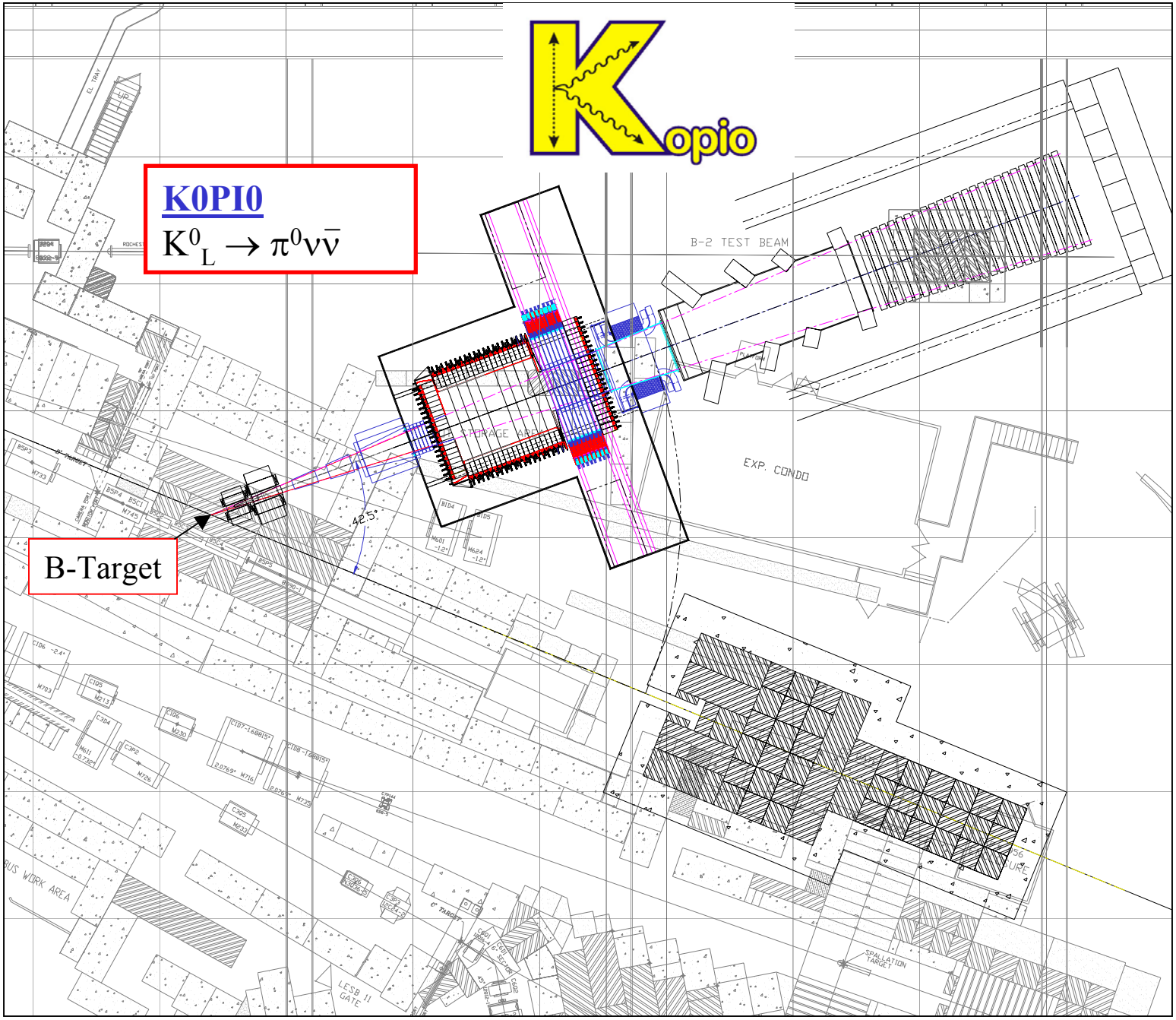
RSVP Experiments

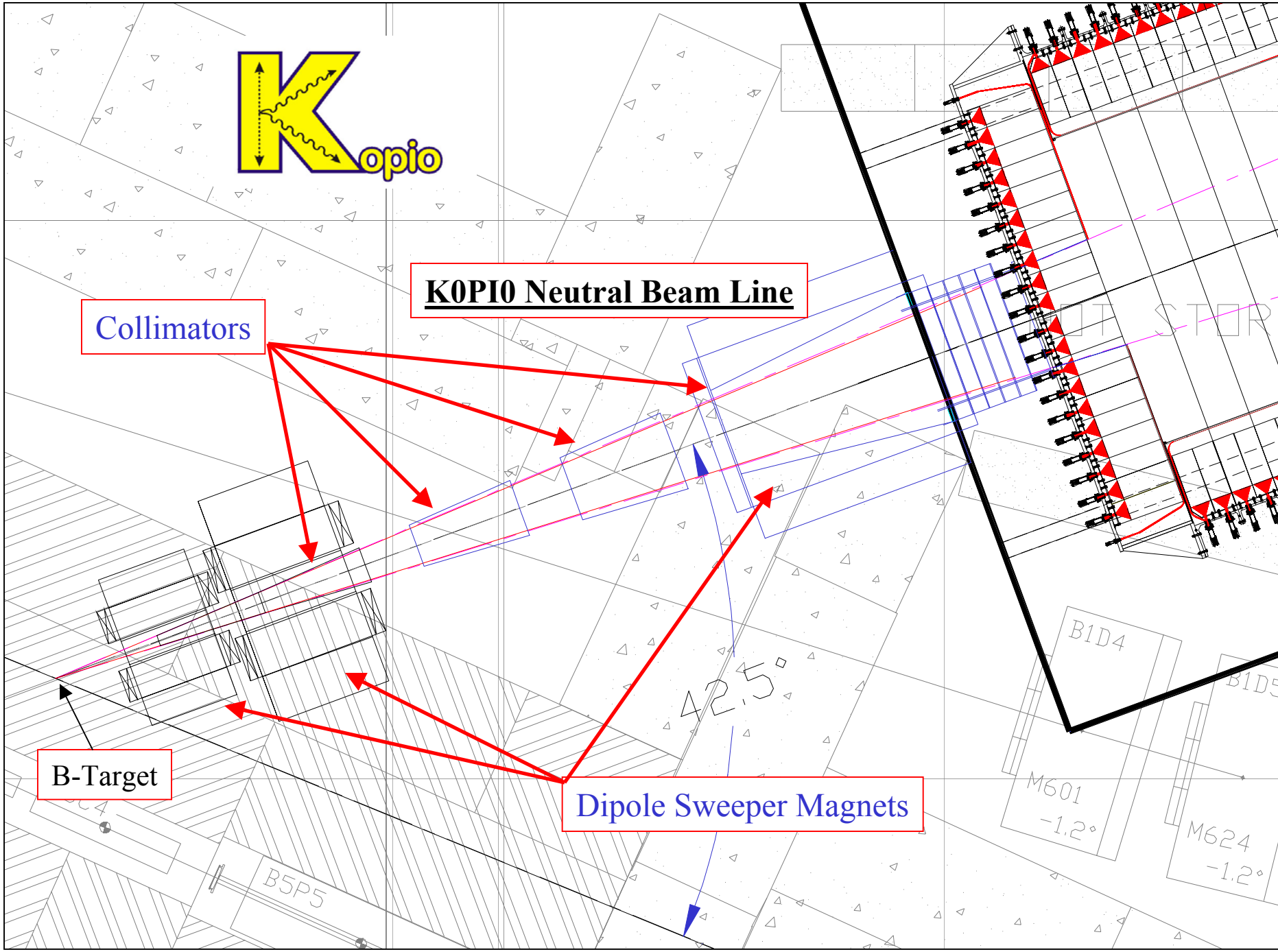
RSVP construction during RHIC operations

- **Present situation – during RHIC injection**
  - Switchyard not accessible with beam in AGS
  - K0PI0 primary cave (B-line) accessible
  - MECO primary cave probably ok, fault study needed
  - ***Almost decoupled from RHIC operations***
- **Plans**
  - AGS extraction beam plug
    - NO SEB
    - Will allow access in switchyard and elsewhere in AGS SEB area
  - New A-line beam plug
    - Will allow beam in any other beam line
    - Will allow work on MECO primary beam from RF Kicker on
  - New B-line beam plug
    - Will allow beam in any other beam line
    - Will allow work on K0PI0 primary beam outside of switchyard
  - ***This decouples RSVP construction from RHIC operations***

RSVP operation with RHIC running

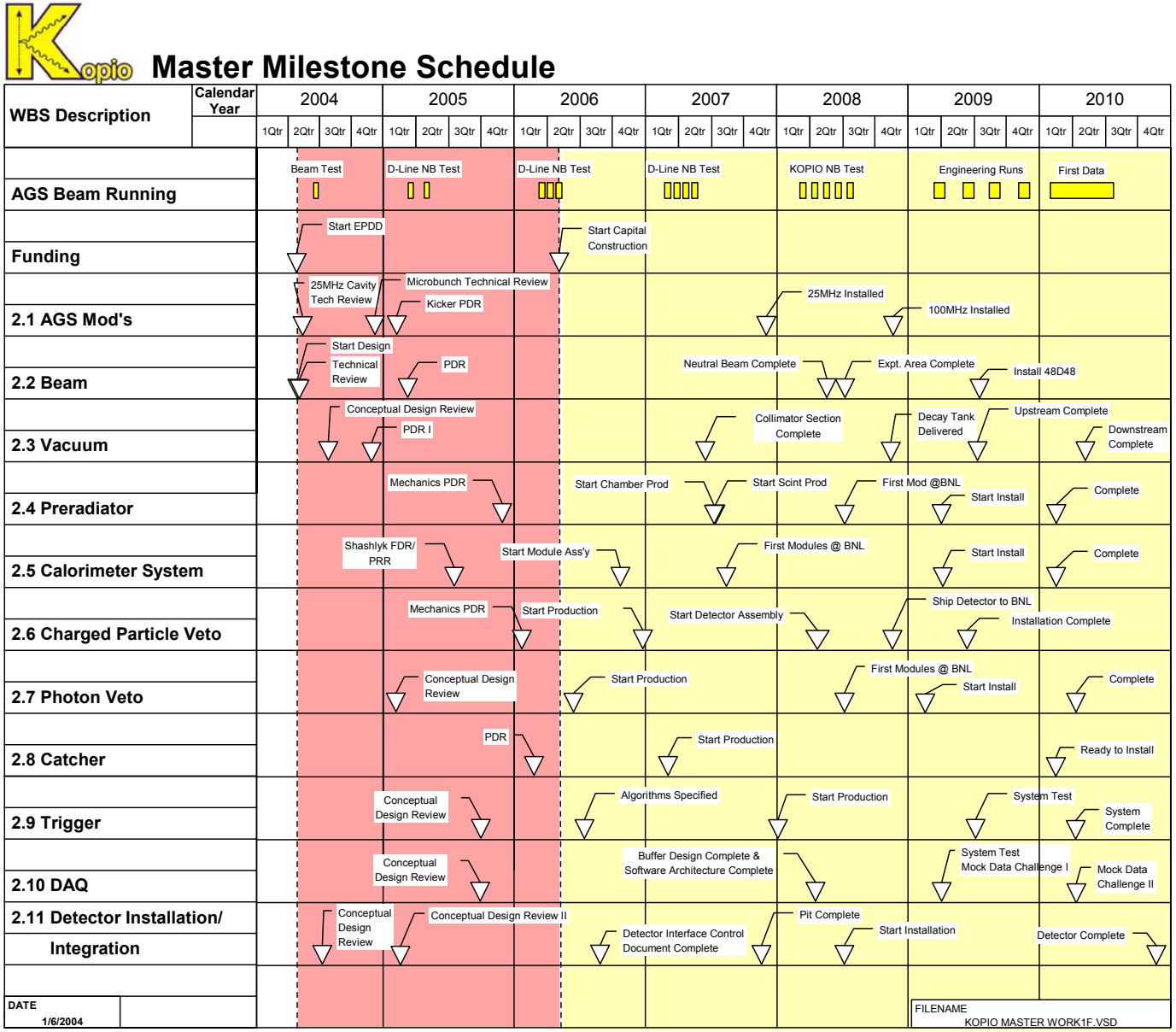
- **Present situation – during RHIC injection**
  - AGS SEB OFF during RHIC injection
  - AGS SEB ON during RHIC stores
    - K0PI0 and MECO Experiments run as an "OR"
    - Our goal is ~ 100 hours per week available for SEB
- ***More on this in the next talk (Roser)***


Kopio
K0PI0
$K^0_L \to \pi^0 \nu\bar{\nu}$
B-Target
B-2 TEST BEAM
EXP. CONDO
42.5°
LESB II GATE
SPALLATION TARGET


Kopio
K0PI0 Neutral Beam Line
Collimators
B-Target
Dipole Sweeper Magnets
42.5°
B1D4
B1D5
M601
-1.2°
M624
-1.2°
B5P5

K0PI0, Master Milestone Schedule

(assumes a FY2006 MRE construction start)

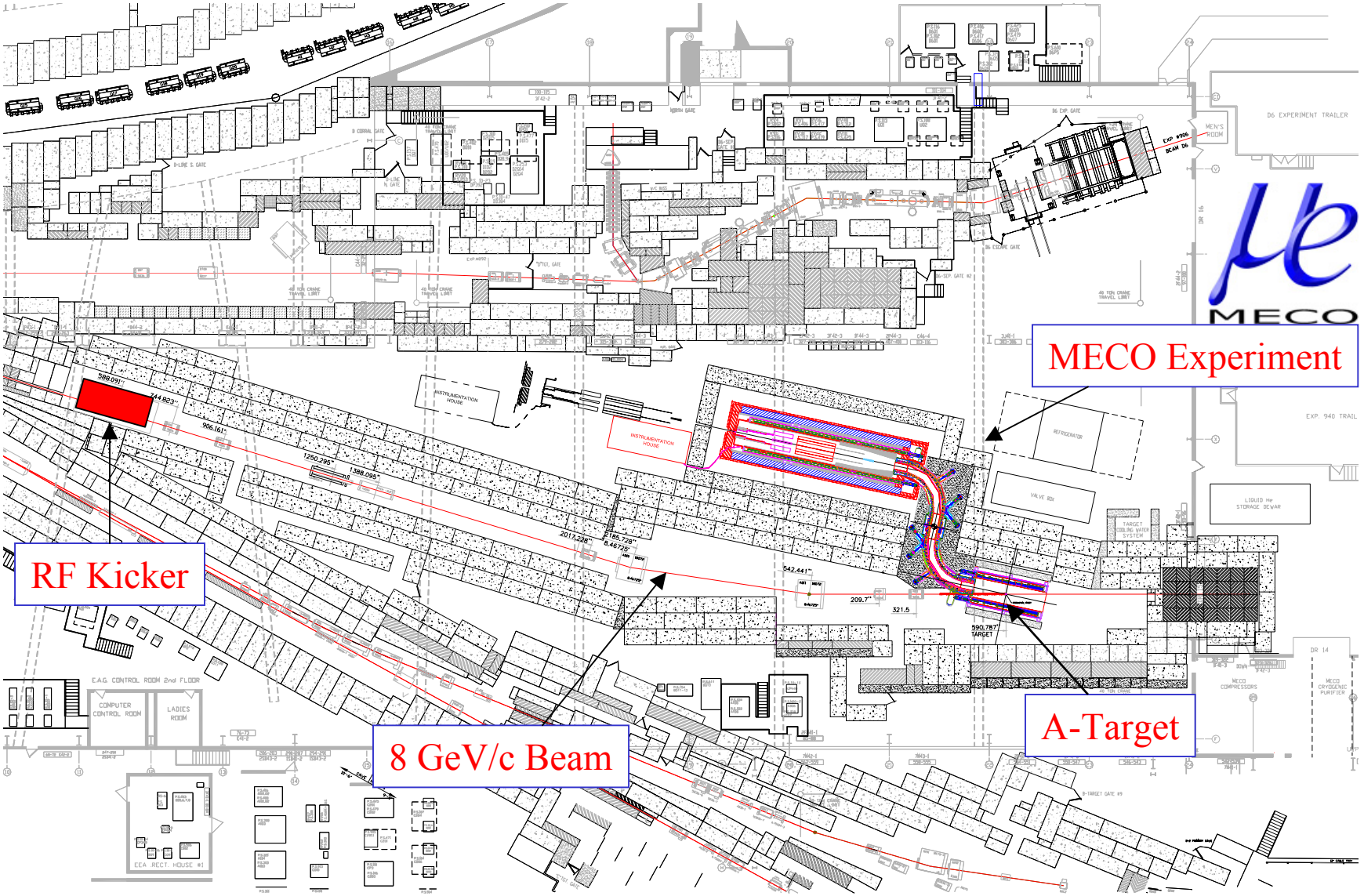


The K0PI0 preliminary test and commissioning time line

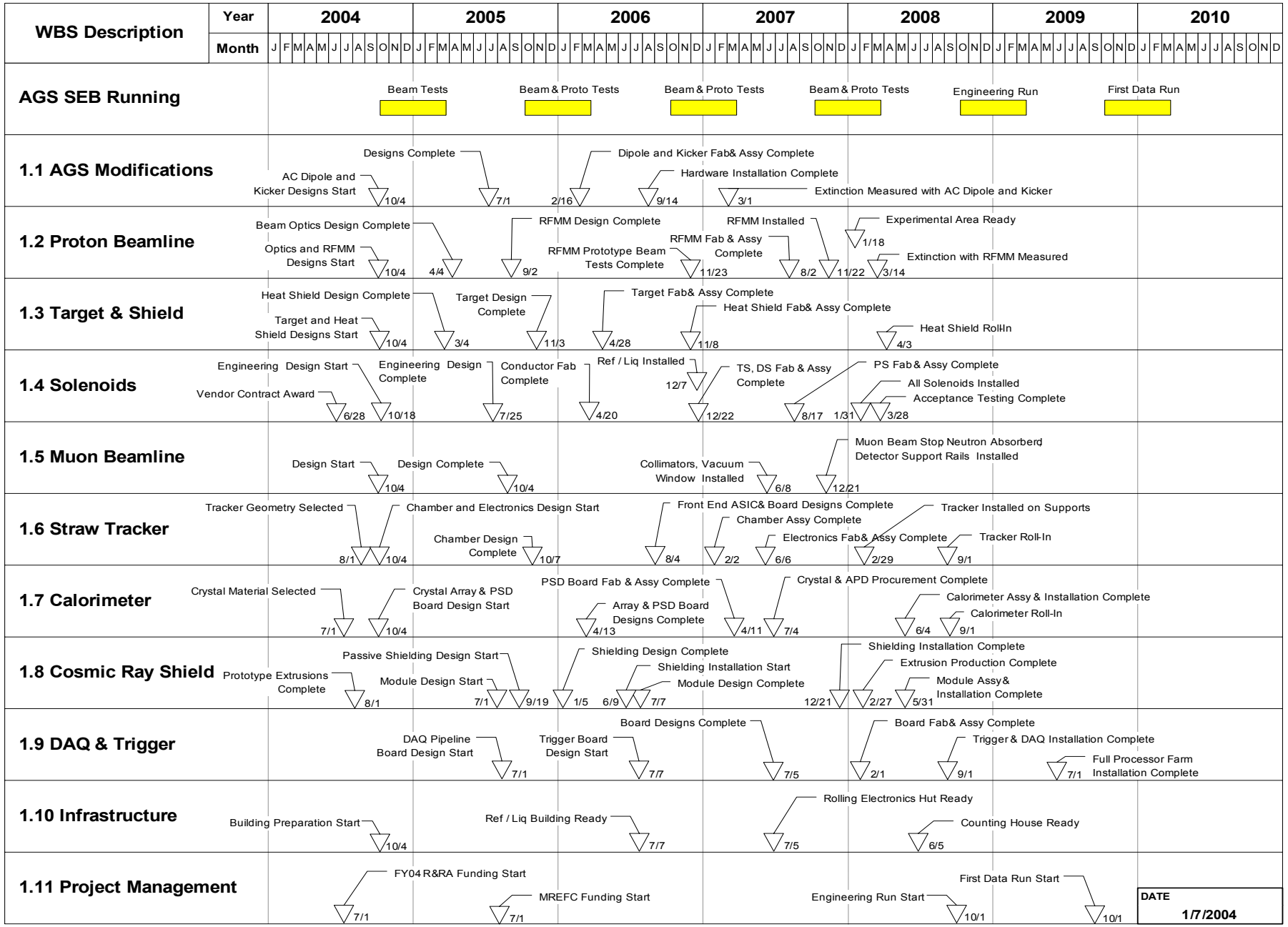
(FY 2006 MRE Start)

	Task	Shifts*
• 2004	Extinction	9
• 2005	RF	25
	Neutral Beam Test	
	Target, Instrumentation	
	Test Beam	14
• 2006	Neutral Beam Test /RF	20
	Test Beam	14
• 2007	Neutral Beam Test	80
	Kicker Commission (CFI)	
	Detector Testing	
	Test Beam	14
• 2008	Primary/Neutral Beam	80
	Detector Testing	
• 2009	Engineering Runs	100
• 2010	Start Data Taking	

* During all the machine development time, these are 12-hour shifts,separated by 12 hours of off-time (works concurrent with RHIC operations or interleaved with other AGS experiments)


MECO Experiment
RF Kicker
8 GeV/c Beam
A-Target

MECO Major Milestone Schedule (Assumes an FY2005 MRE Construction Start)



Current estimate of MECO beam needs during the development and commissioning phases.

FY	Tasks	AGS* Shifts
04	Study low energy extraction and mini-bunching without AGS hardware modifications	17
05	Single bunch intensity studies Mini-bunching studies Detector prototype tests	18 3 15
06	Combined mini-bunching and high single bunch intensity Production target heating tests at high intensity Detector prototype tests	13 12 30
07	Extinction study with AGS internal hardware modifications Beam line commissioning and prototype RFMM module test Detector calibration	20 40 30
08	Test extinction with full RFMM installed Detector calibration	40 60
09	Engineering Run	100

- During all the machine development time, these are 12 hour shifts, separated by 12 hours of off time (works concurrent with RHIC operations or interleaved with other AGS experiments)

RSVP Construction – Impact on RHIC

- Except for AGS modifications (see Roser presentation – next), RSVP construction will be independent of the RHIC operations state

  ➢ **NO IMPACT**

- A combination of present C-AD personnel and new hires will be used for RSVP construction. If conflicts arise between RHIC and RSVP priorities for shared personnel, RHIC wins and RSVP issue have to be worked out to not impact RHIC

  ➢ **NO IMPACT**

RSVP Construction Cost

- K0PI0 and MECO have prepared detailed Work Breakdown Structures for all tasks associated with the construction effort, including AGS modifications and construction of new proton beam lines, as well as management tasks including quality assurance, cost and schedule tracking, integration, and safety

- The following table show the costs as broken down by K0PI0 and MECO for the MRE construction phase with C-A part separated out

NSF MRE Funding by Phase

(does not include non-US or pre-operations funding)

NSF RSVP, KOPIO and MECO Construction Profile (Draft)

(Dollars in Millions)

Description	FY2006	FY2007	FY2008	FY2009	FY2010	Total
Total NSF KOPIO	$11.5	$16.4	$16.9	$7.8	$3.3	$55.9
C-AD part of above budget	$6.7	$4.3	$2.9	$1.8	$1.6	$17.3
Effort C-AD FTE	16	13	9	8	7	53
Total NSF MECO	$18.5	$26.3	$27.1	$12.5	$4.7	$89.0
C-AD part of above budget	$4.6	$4.0	$2.0	$1.4	$0.1	$12.1
Effort C-AD FTE	18	16	8	6	1	49
Total NSF RSVP (KOPIO/MECO)	$30.0	$42.7	$44.0	$20.3	$8.0	$144.9
C-AD part of above budget	$11.3	$8.3	$4.9	$3.2	$1.7	$29.4
C-AD RSVP FTE's	34	29	17	14	7	102

Operations Cost Basis

General Considerations

- The costs to operate (as with construction) the RSVP experiments are calculated incremental to the costs of RHIC operations

- AGS fixed target operations costs are based on past experience with HEP and NP experiments as well as NASA, NNSA and BES experiments

- This incremental and cost sharing model had been the case at the AGS, for the period of 1986-2002, between HEP and NP during the pre-RHIC and into the RHIC era

Operations Cost Basis

RSVP Specific Considerations - schedule

- AGS slow extracted beam (SEB) operations for RSVP will run concurrent with RHIC collider operations when possible
  - Running concurrent with RHIC operations will require base personnel (12 FTE's plus 4-6 experiment specific FTE's) support for the AGS fixed target operation
  - Without base support short runs are costed on a per hour basis for personnel and materials and scheduled outside of RHIC operations
    - **Such runs are considered on a case-by-case basis and are carried out only if the impact on RHIC shutdown work is acceptable**
- During RHIC injection all other machine operations will cease, so as to allow full attention to this process.

Operations Cost Basis

RSVP Specific Considerations – energy use and materials

- Power costs are billed on an actual use basis
  - RHIC pp operations covers first 7 MW
  - RHIC HI Operations covers first 5 MW
- Materials are billed according to previously established average costs
  - M&S, DTS and special procurement for AGS/Experiment concurrent with RHIC operations is charged incremental to RHIC
  - M&S, DTS and special procurement for RSVP operation outside of RHIC operations is fully charged (no RHIC help). Only shift differential (15%), however, is charged for accelerator machine operations staff

Operations Cost Basis

RSVP Specific Considerations - Personnel

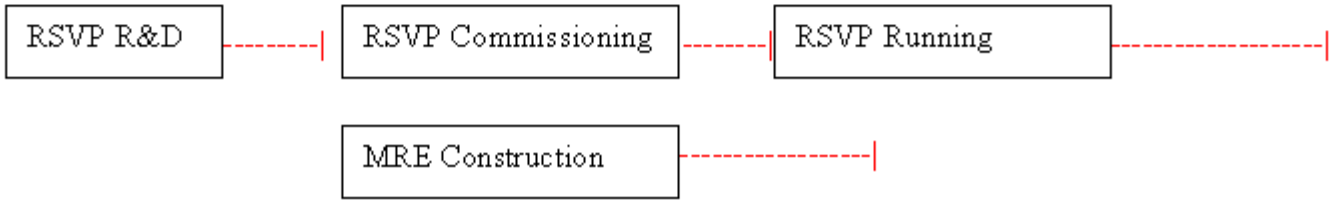
- Since the RHIC program does not support any manpower for AGS experiments all experimental area manpower support will be billed to the NSF consisting of:
  - a base manpower level that supports the extraction system, switchyard transport, primary proton transport and the primary target area (common to both RSVP experiments)
  - Incremental manpower for each experiment
- RSVP manpower is matrixed into the Collider-Accelerator Department staff
  - Main control room operations is sufficient to cover SEB operations during RHIC collision operations except for an incremental effort to support the SEB extraction system
  - RSVP support personnel will come from the present C-AD staff together with new hires
  - C-AD RSVP support personnel will retain RHIC responsibilities at a reduced level
  - When a conflict between RHIC and RSVP support arises, RHIC support will win in all cases that could impact RHIC operations

RSVP Sample Operations Cost

Table V: C-AD RSVP Estimated Incremental Operations Cost Summary

(Constant FY03 Dollars in Millions, assumes PHENIX decadal run scenario is followed and constant effort RHIC budget)

Running Weeks	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014
RHIC WEEKS	27	27	27	27	27	27	27	27	27	27	27
KOPIO WEEKS	1.4	4.3	7	9	6	7	9.5	13.5	10	27	20
MECO WEEKS	1.2	2.6	4	6	7	7	9.5	13.5	17	0	0
Total RSVP Ops Costs	$1.5	$3.9	$6.2	$6.2	$6.7	$6.1	$8.7	$11.0	$12.2	$11.0	$9.0
Total OPS Effort C-AD	0	0	16	16	16	16	18	18	18	16	16
Fixed	0	0	12	12	12	12	12	12	12	12	12
MECO/KOPIO	0	0	4	4	4	4	6	6	6	4	4



RSVP Operations – Impact on RHIC

- RSVP will OFF during RHIC injection (present plan)
- If the AGS is needed for RHIC beam development then RSVP is off

➢ **NO IMPACT**

RSVP D&D Costs

(work in progress)

- The D&D plan for RSVP is to restore the AGS floor to the pre-RSVP condition within a reasonable number of years after the end of experiment operations
- It is recognized that the experiments will generate significant amount of beam activated components that will have to be disposed of and a 2-3 year “cool-down” period will be required before D&D can begin
- The slow beam transport will decommissioned starting at the point where it leaves the switchyard shielding to the RSVP targets
- All commonly reused valuable equipment such as magnets will be stored except for equipment specific to the RSVP experiments, these will be considered radioactive waste

RSVP D&D Costs

(work in progress)

- The cost of removing and disposing of the experiments will be included
- Shielding under 5mr will be left in building 912
- All concrete floor areas over 5mr will be removed and replaced, but no radioactive soil remediated
- Power and water modifications for RSVP will be removed except where considered an upgrade to existing utilities
- The AGS and Booster will remain operational for RHIC when RSVP is complete so the only D&D envisioned will be for those components added specifically for RSVP and not required for future operation
- It is anticipated that incremental D&D costs will be assessed yearly over the length of the planned operation of the RSVP project, by a panel appointed by the DOE and NSF, with funds placed in a suitable escrow account

These cost estimates have NOT been reviewed and are presented for general guidance only!

RSVP D&D Cost Summary

The below costs are in millions of FY 2003 dollars, ***fully burdened***

Experiment	**Estimated D&D Cost**
K0PI0	$5.3
MECO	$5.3
Contingency	$2.7
Total Estimated Cost	**$13.3**

RHIC/RSVP Experimental Operations & RSVP Installation - Final Comments

- **Technical scope of the RSVP project is ideally suited to expertise available in the C-AD**
- **RSVP construction will be supported with no significant impact to the operations of RHIC or to RHIC shutdown activities**
- **RSVP operations costs will not be subsidized by RHIC**
- **Additional RSVP operations staff will enhance RHIC operations**
- **Modest R&D funding for RSVP is in hand with a significant increase expected by this spring or summer**
- **A final integration of RSVP construction into the RHIC schedule is set to proceed once funding is in place**
- **Ready for a year 2006 (or 2005) construction start**

Supplemental Information

NSF RSVP Funding Profile

Table II – NSF RSVP Funding Profile - R&RA , MREFC

NSF RSVP Funding Profile - R&RA , MREFC

(Millions of Dollars)

	Concept Develop		Implementation		Ops/Maint		Totals		
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Grand Totals
FY2000 and Prior									
FY2001	$0.90	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	$0.00	$0.90
FY2002	1.20	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.20
FY2003 REQ	1.20*	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.20
FY2004 REQ	1.50*	0.00	0.00	0.00	0.00	0.00	1.50	0.00	1.50
FY2005 EST	2.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	2.00
FY2006 EST	2.00	0.00	0.00	30.00	5.30	0.00	7.30	30.00	37.30
FY2007 EST	0.00	0.00	0.00	42.66	8.50	0.00	8.50	42.66	51.16
FY2008 EST	0.00	0.00	0.00	44.00	8.50	0.00	8.50	44.00	52.50
FY2009 EST	0.00	0.00	0.00	20.25	13.50	0.00	13.50	20.25	33.75
FY2010 EST	0.00	0.00	0.00	8.00	14.30	0.00	14.30	8.00	22.30
FY2011 EST	0.00	0.00	0.00	0.00	14.80	0.00	14.80	0.00	14.80
Subtotal R&RA	$8.80		$0.00		$64.90		$73.70		$73.70
Subtotal MREFC		$0.00		$144.91		$0.00		$144.91	$144.91
Total each Phase		$8.80		$144.91		$64.90		$218.61	$218.61

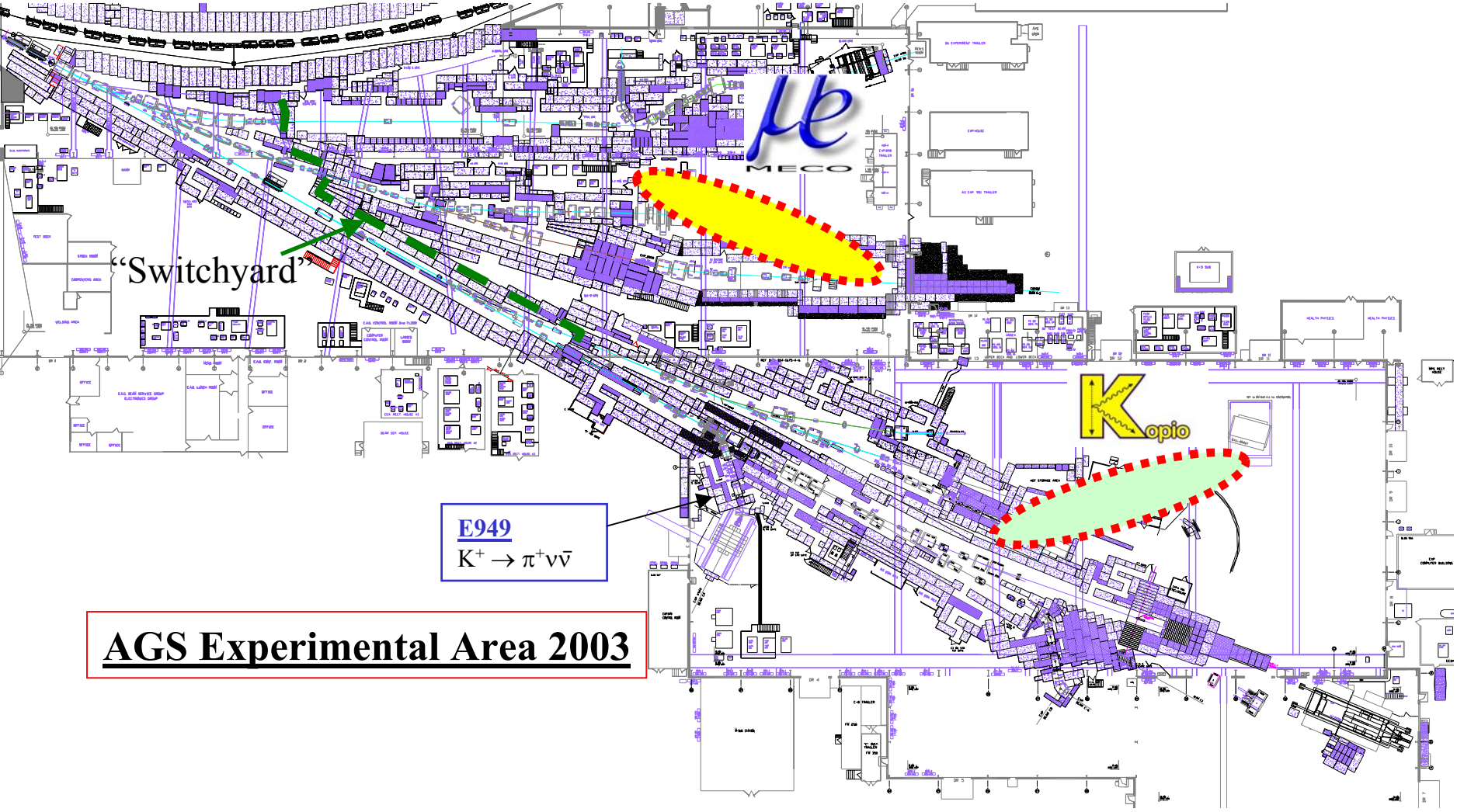
Source: NSF Major Research Equipment and Facilities Construction Budget (FY2004 Budget Request)

*Note: FY03 actual funding was $1m, FY04 Omnibus Bill currently in Senate shows $6M.

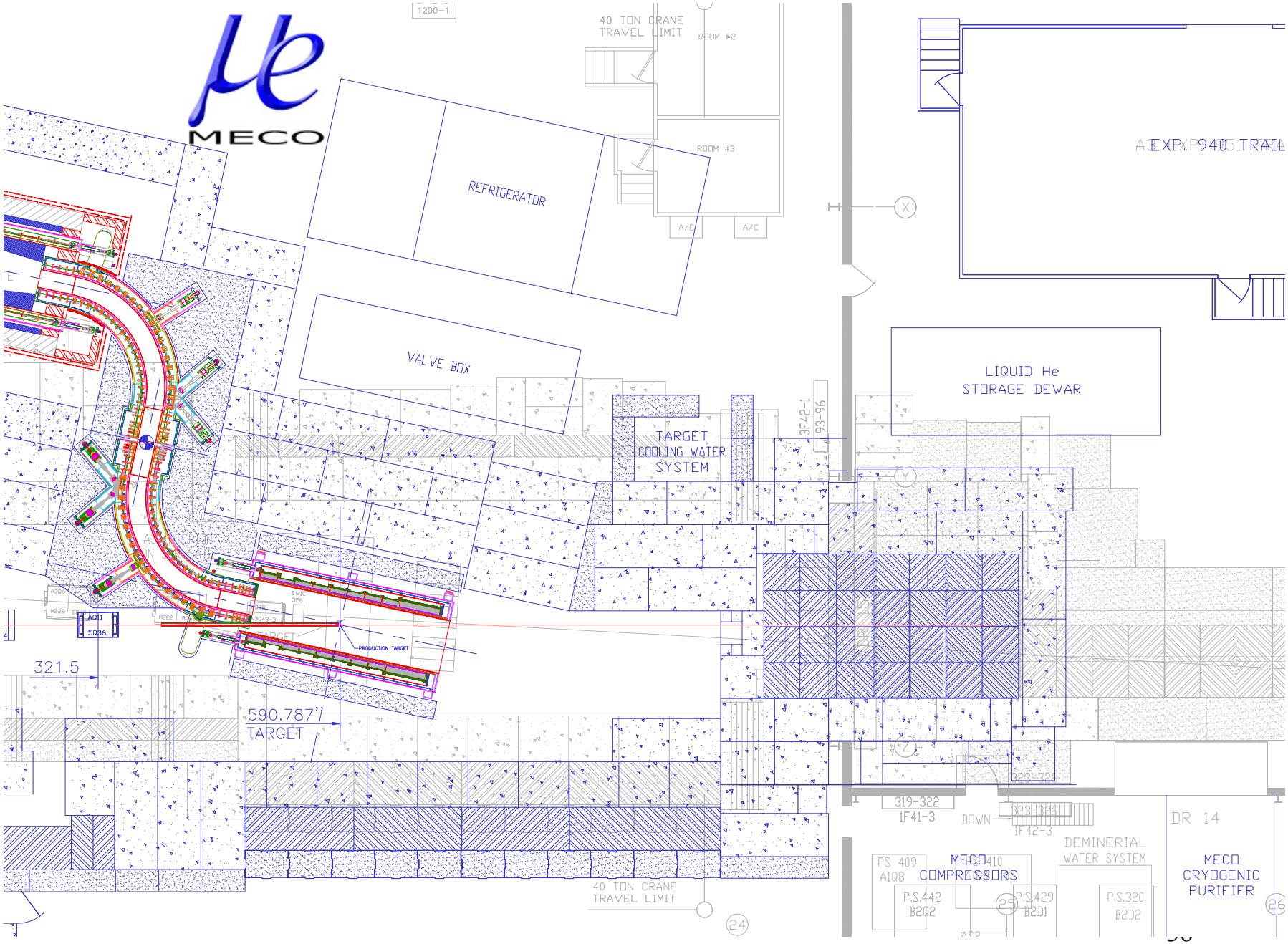
NSF RSVP Current Project Milestones (preliminary)

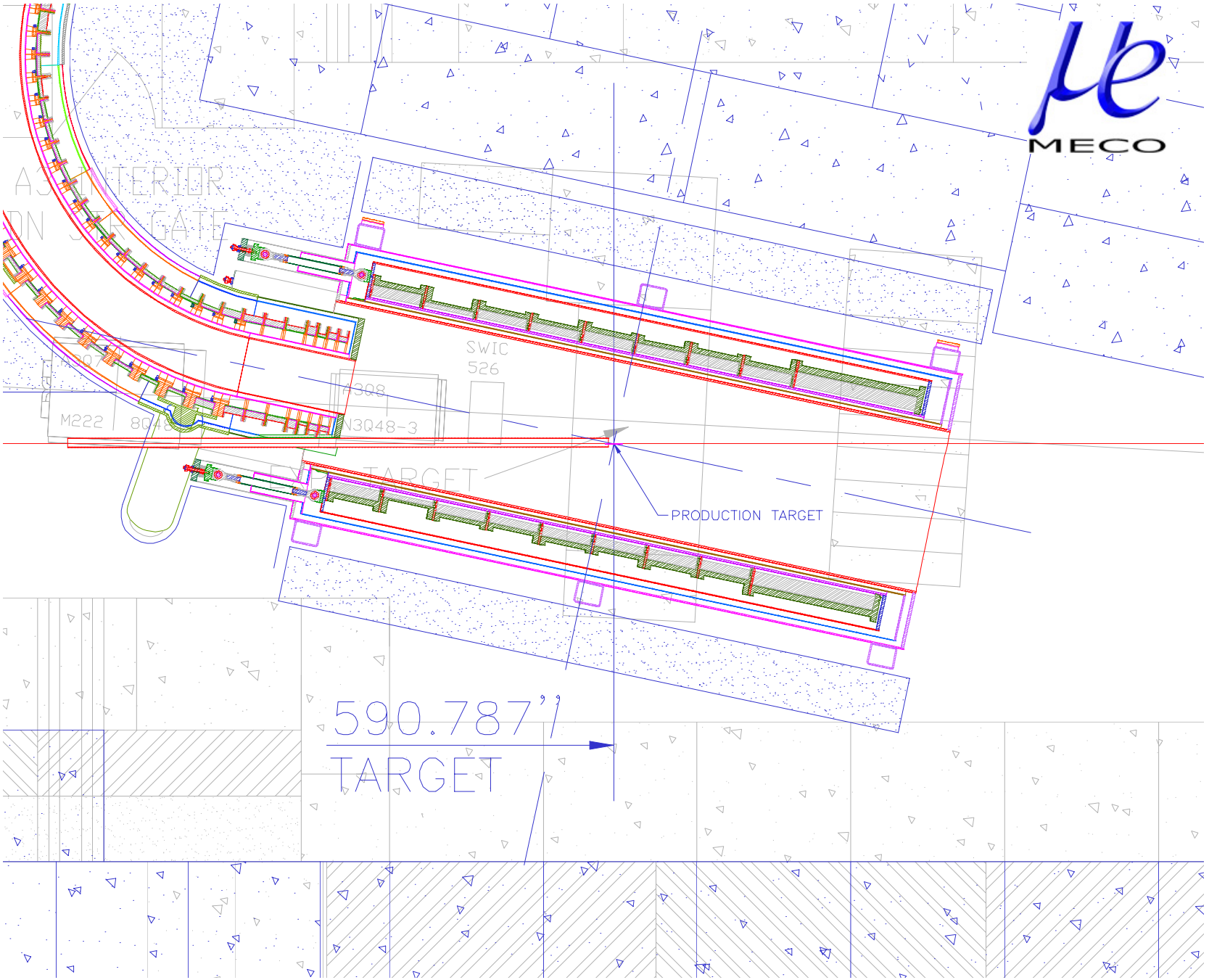
Source: NSF Major Research Equipment and Facilities Construction Budget (FY2004 Budget Request)

FY 2005	Complete Magnet Design
FY 2006	Begin Construction
	Complete AGS Design Modifications
	Deliver and Integrate Magnet Coils
FY 2007	Complete Detector Component Prototypes
	Complete Construction of AGS Beam
FY 2008	Start Detector Component Production
	Complete Initial Modules
FY 2009	Complete Data Acquisition System and Trigger Design
	Deliver Detector Components
	Complete Magnet Tests with Installed Detector Elements
FY 2010	Perform Engineering Run
	Complete Construction



AGS Experimental Area 2003


40 TON CRANE
TRAVEL LIMIT
ROOM #2
ROOM #3
REFRIGERATOR
A/C
A/C
VALVE BOX
LIQUID He
STORAGE DEWAR
TARGET
COOLING WATER
SYSTEM
3F42-1
93-96
321.5
590.787"
TARGET
PRODUCTION TARGET
319-322
1F41-3
DOWN
1F42-3
DEMINERIAL
WATER SYSTEM
DR 14
MECO
CRYOGENIC
PURIFIER
PS 409
A108
MECO
COMPRESSORS
P.S.442
B2C2
P.S.429
B2D1
P.S.320
B2D2
40 TON CRANE
TRAVEL LIMIT
24
25
26


MECO
SWIC
526
PRODUCTION TARGET
590.787"
TARGET

RSVP and E949 Example Run Plan

Assumptions	1/26/2004	ppile										
FY 2003 Dollars, full NSF Indirects												
K0PI0 total hours	8000	80	weeks	Beginning in 5th year of construction (last year)								
MECO total hours	4000	40	weeks	Beginning in 5th year of construction (last year)								
Power cost	$ 85.00	per MWhr	FY 2006 and beyond									

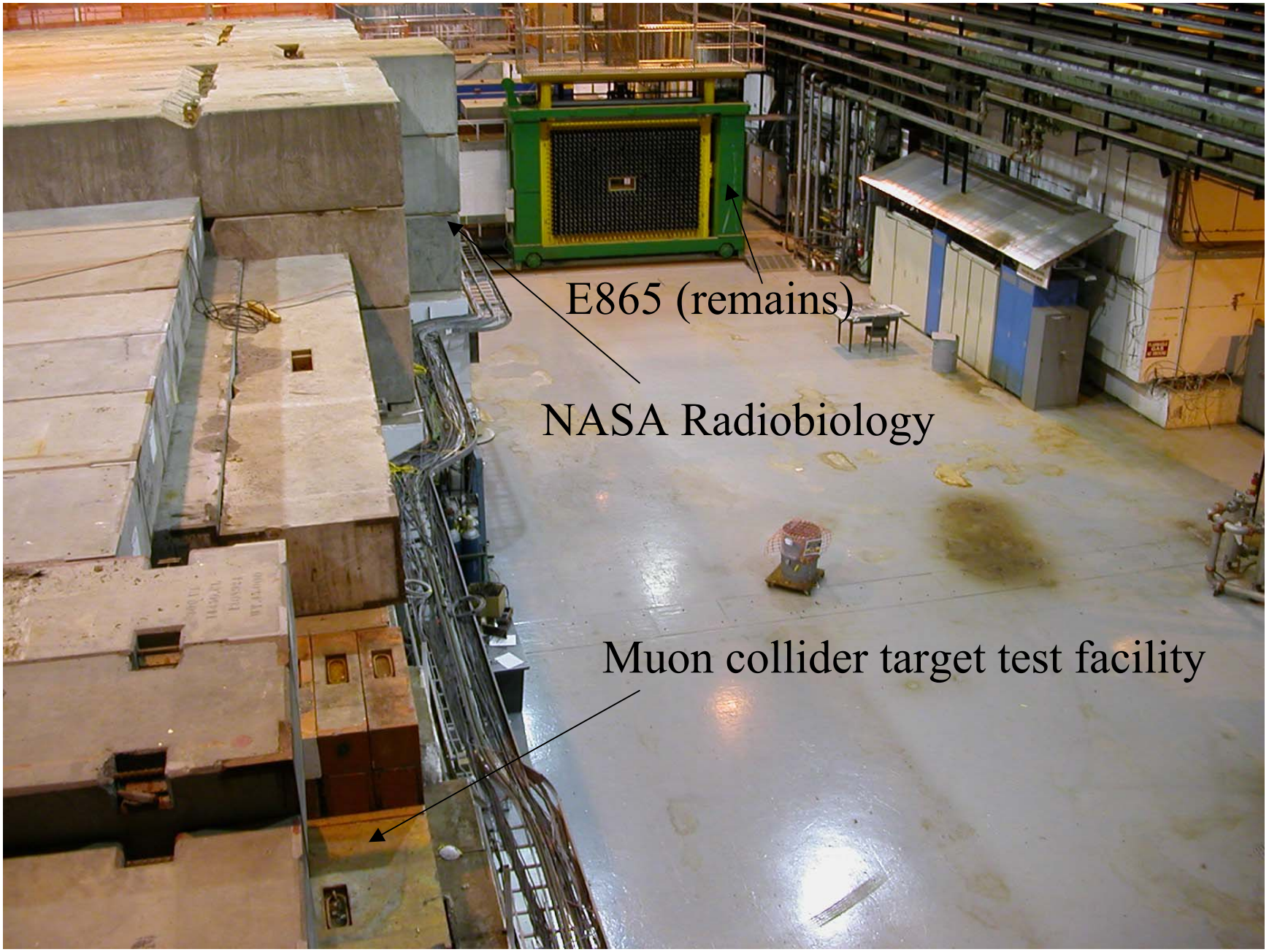
	FY04	FY05	FY06#	FY07#	FY08#	FY09	FY10	FY11	FY12	FY13	FY14
RHIC Weeks Total	27	27	27	27	27	27	27	27	27	27	27
Available with pp*	0	5	0	19	0	19	0	19	0	19	0
Available with HI*	14	9	19	0	19	0	19	0	19	0	19
			← MRE Construction Years →								
With RHIC HI											
K0PI0	0	0	7	0	6	0	9.5	0	9.5	0	19
MECO	0	0	4	0	7	0	9.5	0	9.5	0	0
E949 with K0PI0	0	0	6	0	5	0	0	0	0	0	0
E949 alone	0	0	8	0	6	0	0	0	0	0	0
With RHIC pp											
K0PI0	0	0	0	9	0	7	0	9.5	0	19	0
MECO	0	0	0	6	0	7	0	9.5	0	0	0
E949 with K0PI0	0	0	0	8	0	0	0	0	0	0	0
E949 alone	0	0	0	4	0	0	0	0	0	0	0
Without RHIC											
K0PI0	1.4	4.3	0	0	0	0	0	4	5.5	8	8
MECO	1.2	2.6	0	0	0	0	0	4	2.5	0	0
E949 with K0PI0	0	0	0	0	0	0	0	0	0	0	0
E949 alone	0	0	0	3	1	0	0	0	0	0	0
Fixed Costs (labor)											
RSVP			$2,421,818	$2,421,818	$2,421,818	$2,421,818	$2,421,818	$ 2,421,818	$ 2,421,818	$ 2,421,818	$ 2,421,818
K0PI0			$ 379,875	$ 379,875	$ 379,875	$ 379,875	$ 455,850	$ 455,850	$ 455,850	$ 759,751	$ 759,751
MECO			$ 379,875	$ 379,875	$ 379,875	$ 379,875	$ 683,776	$ 683,776	$ 683,776	0	0
Other Costs (scales)			RSVP Commissioning				RSVP Running Years				
RSVP			$1,530,772	$1,496,388	$1,809,094	$1,396,629	$2,644,061	$ 3,748,838	$ 4,497,475	$ 3,748,838	$ 4,497,475
K0PI0	$ 820,558	$2,520,284	$ 992,997	$1,011,960	$ 851,140	$ 787,080	$1,347,639	$ 2,018,025	$ 2,653,676	$ 4,036,050	$ 4,594,969
MECO	$ 646,232	$1,400,169	$ 486,053	$ 552,579	$ 850,594	$ 644,676	$1,154,377	$ 1,690,439	$ 1,664,078	$ -	$ -
TOTAL RSVP Operations Cost	**$1,466,789**	**$3,920,453**	**$6,191,391**	**$6,242,495**	**$6,692,397**	**$6,009,952**	**$8,707,521**	**$ 11,018,745**	**$12,376,673**	**$10,966,456**	**$12,274,012**
E949 Operations Cost			E949 Running Years								
Fixed (labor)			$ 190,255	$ 190,255	$ 190,255						
Other (scales)			$2,871,960	$3,016,385	$2,686,467						
Total E949 Operations Cost			**$3,062,215**	**$3,206,640**	**$2,876,722**						
Weeks per year											
K0PI0	1.4	4.3	7	9	6	7	9.5	13.5	15	27	27
MECO	1.2	2.6	4	6	7	7	9.5	13.5	12	0	0
E949	0	0	14	15	12						
Total Weeks of Physics Running			E949 Integrated Weeks				RSVP Integrated Weeks				
K0PI0							9.5	23	38	65	92
MECO							9.5	23	**35**		
E949	0	0	14	29	**41**						

K0PI0 Plan	12000 hrs	150	80 hr weeks
MECO Plan	2777 hrs	35	80 hr weeks

*Based on PHENIX Decadal plan and constant effort scenario through FY10

assmes experiments pay for 12 FTE base manpower plus an additional 4 FTE (shared) during first 3 years of beam development

A3 (future MECO) Beam Line – beam left 2004



A3 (future MECO) Beam Line – beam right 2004

B5 (future K0PI0) Beam Line 2004